



## NASA SBIR 2006 Phase I Solicitation

### X3.02 Water Processing and Waste Management

Lead Center: JSC

Participating Center(s): ARC, GRC, KSC, MSFC

Advanced life support systems will be essential to enable human planetary exploration as outlined in the Vision for Space Exploration. These future systems must provide additional mass balance closure to further reduce logistics requirements and to promote self-sufficiency. Requirements include safe operability in micro- and partial-gravity as well as ambient and reduced-pressure environments, high reliability, regeneration, minimal use of expendables, ease of maintenance, and low system volume, mass and power. Proposals should explicitly describe how the work is expected to improve power, volume, mass, logistics, crew time, safety and/or reliability, giving comparisons to existing state-of-the art technologies. Although this solicitation is directed at technologies for lunar missions, crosscutting technologies that are also applicable to human missions to Mars or that are compatible with both partial and microgravity environments may be of interest. Technologies that perform several functions or that eliminate the need for intermediate processing steps are also of interest. Additional documentation and information can be found at <http://advlifesupport.jsc.nasa.gov>, including the expected composition of solid wastes and wastewater which can be found within the "Baseline Values and Assumptions Document".

#### Water Reclamation

Efficient, direct treatment of wastewater and product water consisting of urine, wash water, humidity condensate, and/or product water derived from in situ planetary resources to produce potable and hygiene water supplies. Treatment methods for long duration lunar surface missions should seek higher levels of mass closure. Treatment methods for short-to-moderate duration lunar missions (several weeks to several months) may have lower recovery rates (

- Stowable small-scale gravity-independent water treatment units for contingency or back up use for treatment of condensate, contaminated potable water or wastewater, which may incorporate flow-through units such as ion exchange, adsorption, multi-filtration and/or osmotic filtration;
- Disinfection and residual disinfectant technologies for potable water storage and point-of-use that are compatible with wastewater processing systems including biological treatment;
- Techniques to minimize or eliminate biofilms, microbial contamination and/or solids precipitation from potable water, wastewater and water treatment system components such as pipes, tanks, flow meters, check valves, regulators, etc.;
- Physicochemical methods for primary wastewater treatment to reduce total organic carbon from 1000 mg/L

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to less than 50 mg/L and/or total dissolved solids from 1000 mg/L to less than 100 mg/L; and

- Post-treatment methods to reduce total organic carbon from 100 mg/L to less than 0.25 mg/L in the presence of 50 mg/L bicarbonate ions, 25 mg/L ammonium ions and 25 ppm other inorganic ions.

### **Solid Waste Management**

Wastes (trash, food packaging, feces, paper, tape, filters, water brines, clothing, hygiene wipes, etc.) must be managed to protect crew health, safety, and quality of life, to avoid harmful contamination of planetary surfaces, and to recover useful resources. Areas of emphasis include:

- Volume reduction of wet and dry solid wastes;
- Small and compact fecal collection and/or treatment systems;
- Water recovery from wet wastes (including human fecal wastes, food packaging, brines, etc.);
- Stabilization, sterilization, and/or microbial control technologies to minimize or eliminate biological hazards associated with waste;
- Mineralization of wastes (especially fecal) to ash and simple volatile compounds (e.g. carbon dioxide and water);
- Containment of solid waste onboard spacecraft that incorporates odor abatement technology;
- Partial-gravity containment devices or systems with low volume and mass that can maintain isolation of disposed waste on planetary surfaces; and
- Microgravity-compatible technologies for the containment and jettison of solid wastes in space.

### **Water Recovery from Byproducts of Water and Waste Processing - Brines and Slurries**

Water recovery systems produce brines and slurries from water processing systems that use technologies such as reverse osmosis and distillation. Dissolved solids and organics can total about 3% to 20% by weight of the solution. Technologies for recovery of water from brines and slurries, which provide an increased level of mass closure of advanced life support systems, are of interest. The products of these systems may be dry solids and purified water low in total organic carbon.